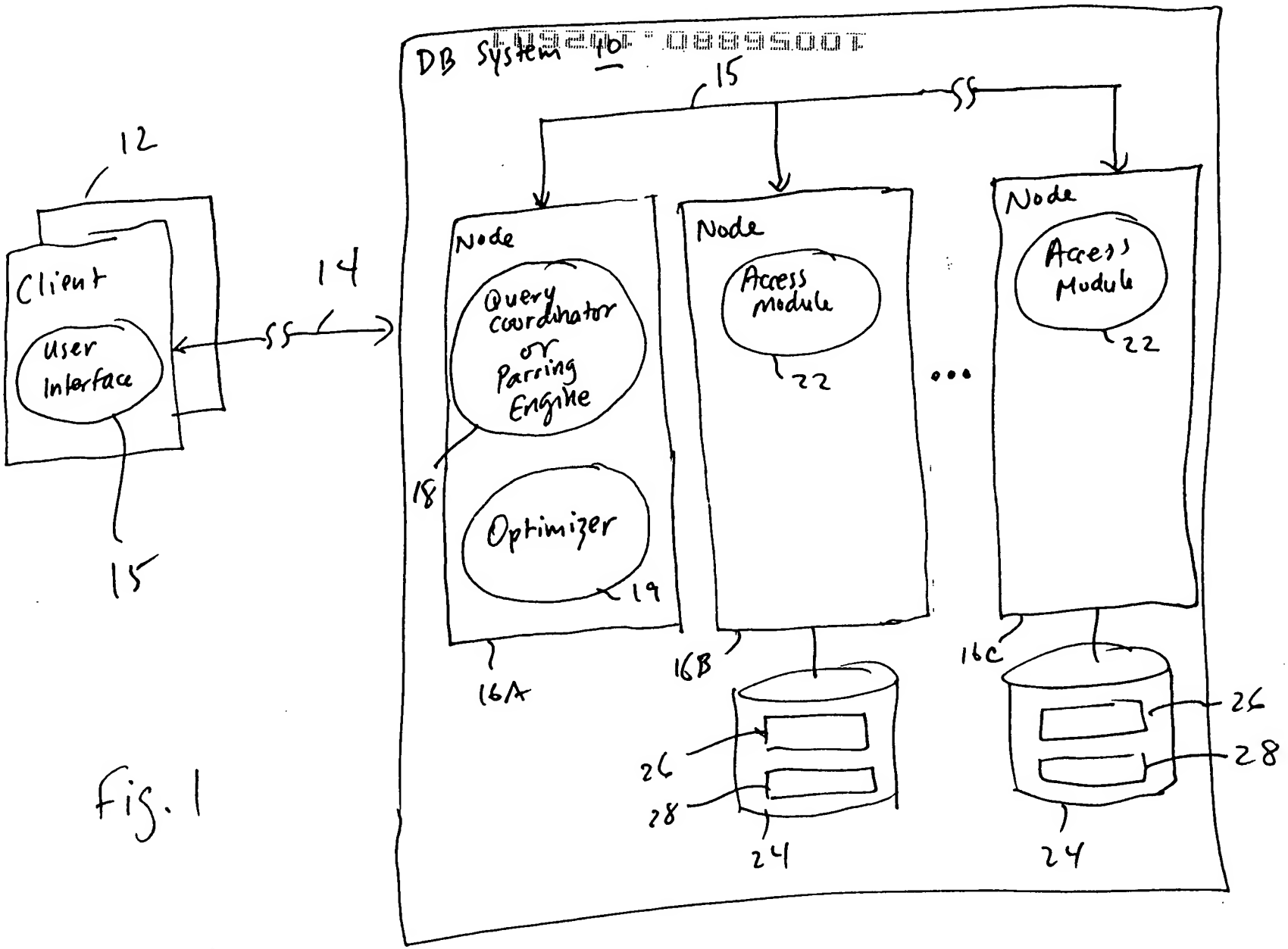

DB System 10
15
12
Client
User Interface
14
15
Node
Query coordinator or Parsing Engine
18
Optimizer
19
16A
Node
Access Module
22
16B
Node
Access Module
22
16C
26
28
24
26
28
24

fig. 1

Select T1.A, T2.B From T1, T2, T3
Where T1.C=99 AND T2.D='george' AND T3.E=66
AND T1.F=T2.F AND T2.G = T3.G;

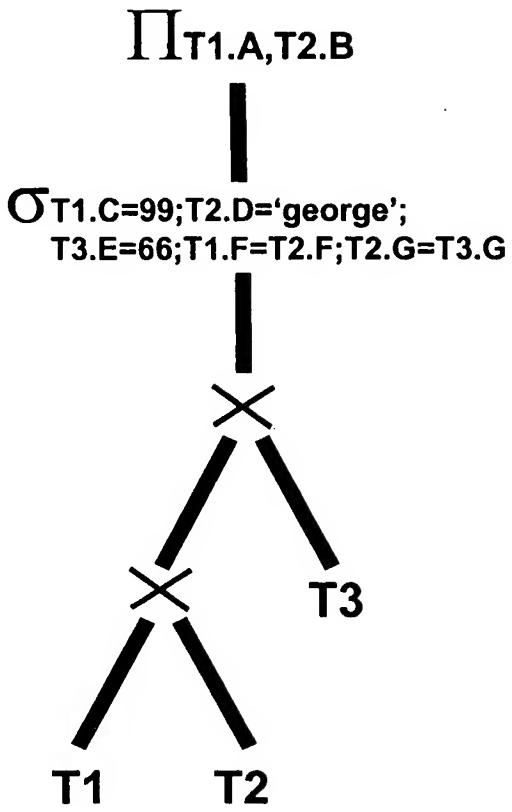


FIG. 2

Select T1.A, T2.B From T1, T2, T3
Where T1.C=99 AND T2.D='george' AND T3.E=66
AND T1.F=T2.F AND T2.G = T3.G;

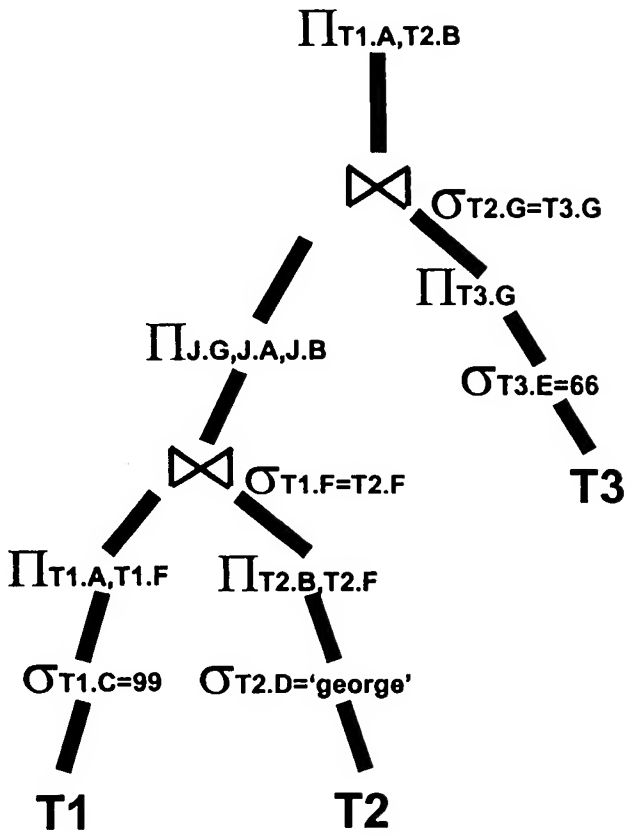


FIG. 3

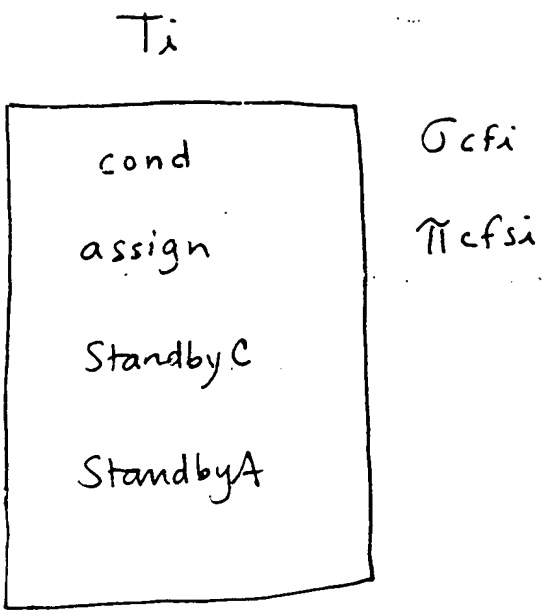


FIG. 4

FIG. 5

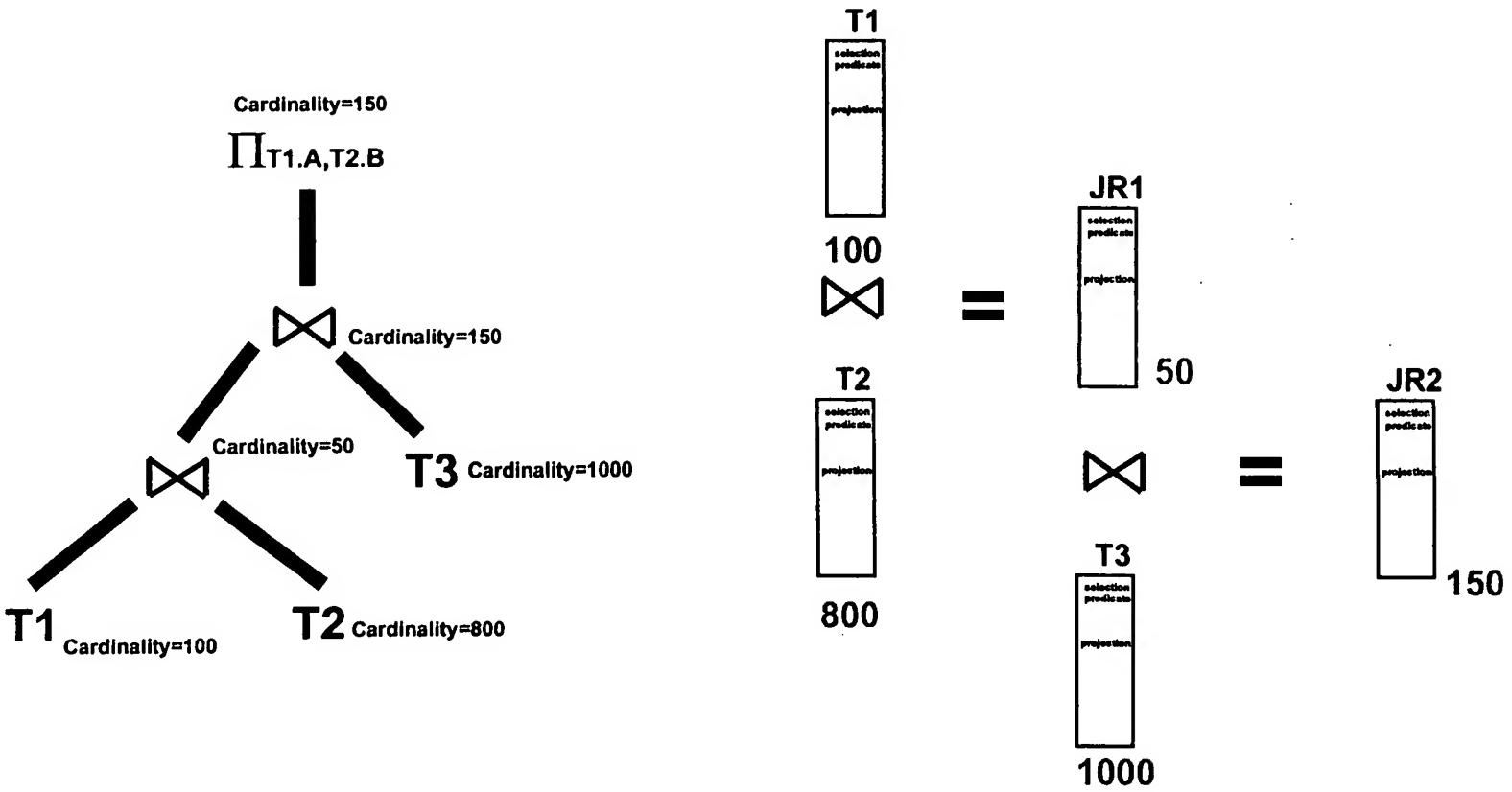
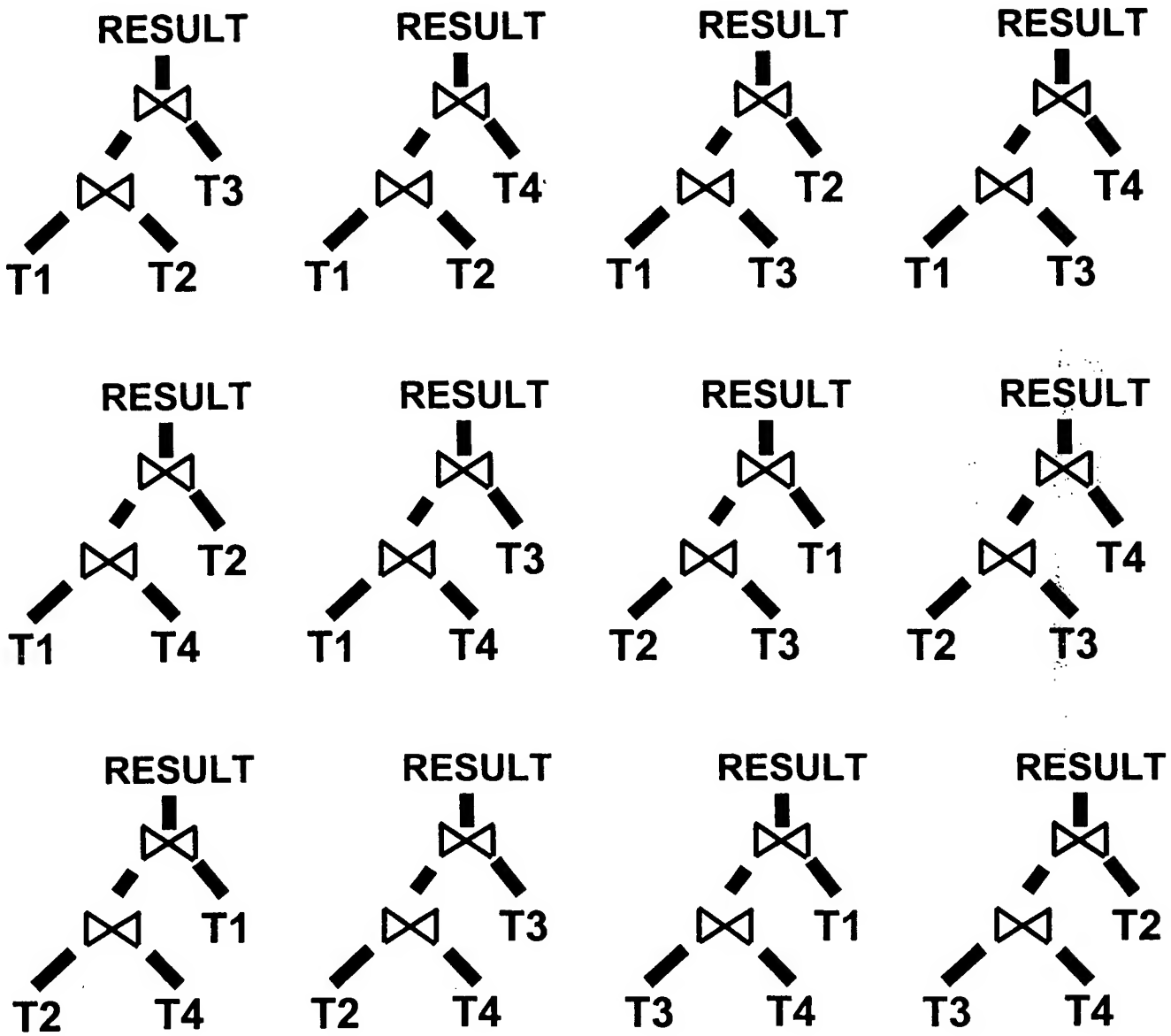

Cardinality=150
ΠT1.A,T2.B
Cardinality=150
Cardinality=50
T3 Cardinality=1000
T1 Cardinality=100
T2 Cardinality=800
T1
100
T2
800
JR1
50
T3
1000
JR2
150

FIG. 6


RESULT
T3
T1
T2
RESULT
T4
T1
T2
RESULT
T2
T1
T3
RESULT
T4
T1
T3
RESULT
T2
T1
T4
RESULT
T3
T1
T4
RESULT
T1
T2
T3
RESULT
T4
T2
T3
RESULT
T1
T2
T4
RESULT
T3
T2
T4
RESULT
T1
T3
T4
RESULT
T2
T3
T4

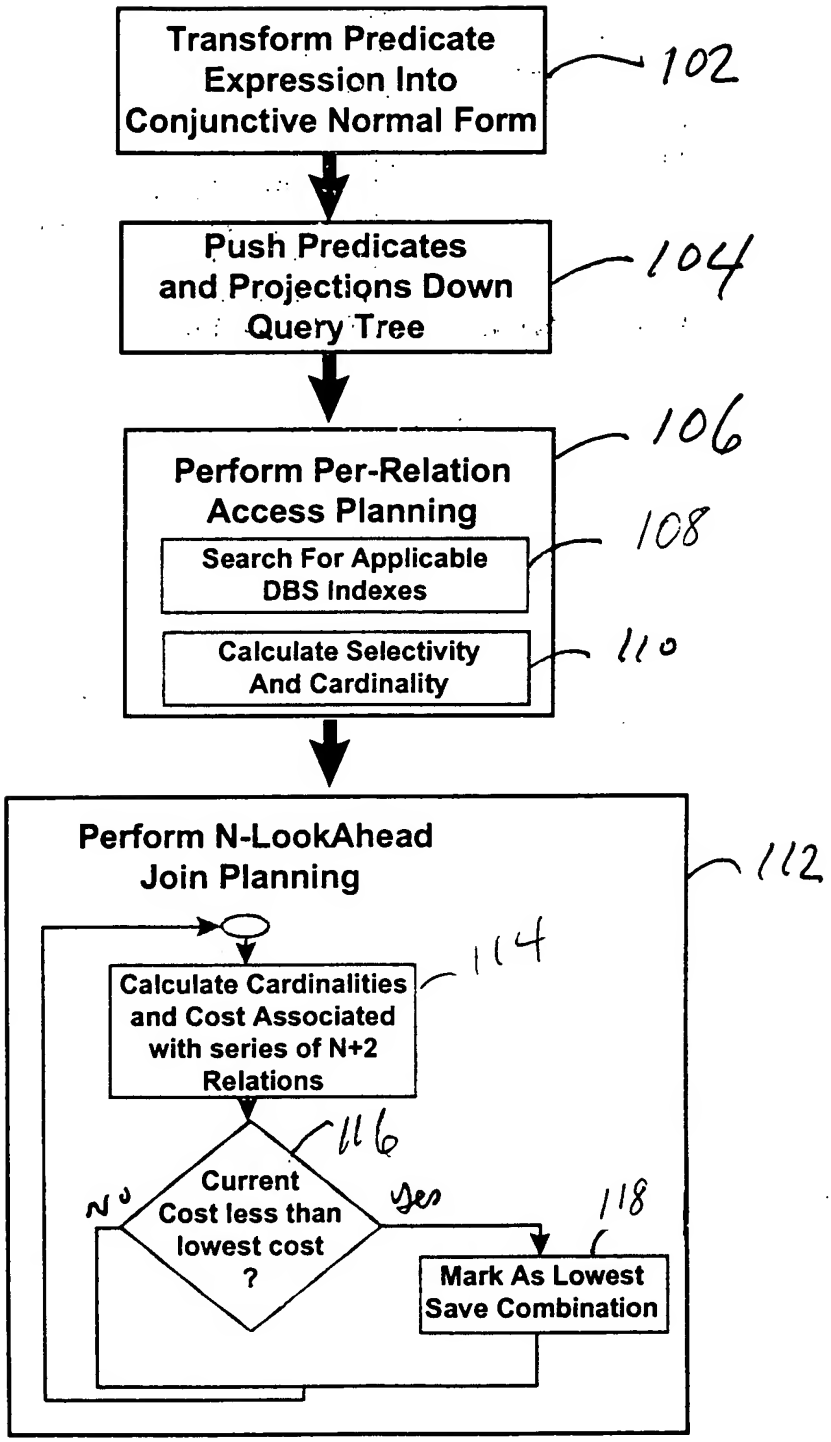

Transform Predicate Expression Into Conjunctive Normal Form
102
Push Predicates and Projections Down Query Tree
104
Perform Per-Relation Access Planning
106
Search For Applicable DBS Indexes
108
Calculate Selectivity And Cardinality
110
Perform N-LookAhead Join Planning
112
Calculate Cardinalities and Cost Associated with series of N+2 Relations
114
Current Cost less than lowest cost ?
116
No
Yes
118
Mark As Lowest Save Combination

FIG. 7

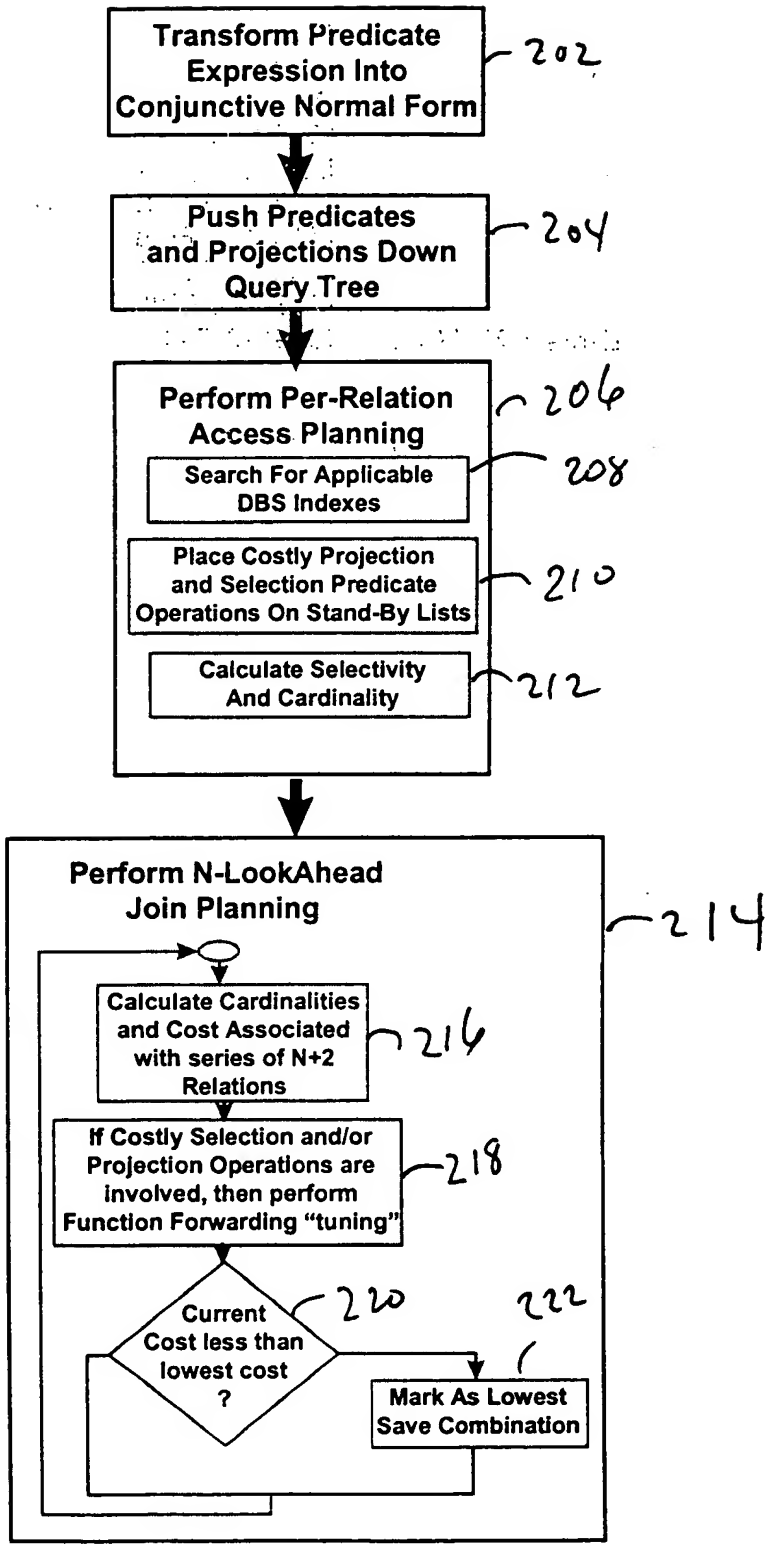

Transform Predicate Expression Into Conjunctive Normal Form
202
Push Predicates and Projections Down Query Tree
204
Perform Per-Relation Access Planning
206
Search For Applicable DBS Indexes
208
Place Costly Projection and Selection Predicate Operations On Stand-By Lists
210
Calculate Selectivity And Cardinality
212
Perform N-LookAhead Join Planning
214
Calculate Cardinalities and Cost Associated with series of N+2 Relations
216
If Costly Selection and/or Projection Operations are involved, then perform Function Forwarding "tuning"
218
Current Cost less than lowest cost ?
220
222
Mark As Lowest Save Combination

Fig. 8

```
Select T1.A, T2.B, T3.Video.Colorize() From T1, T2, T3, T4
    Where T1.face = IMAGE(\\url\myface.jpg)  AND T2.D='george'
        AND T4.Audio = AUDIO(\\url\georgeharrison.wav)
            AND T1.F=T2.F AND T2.G = T3.G AND T1.H = T4.H
                AND T2.K=T4.K;
```

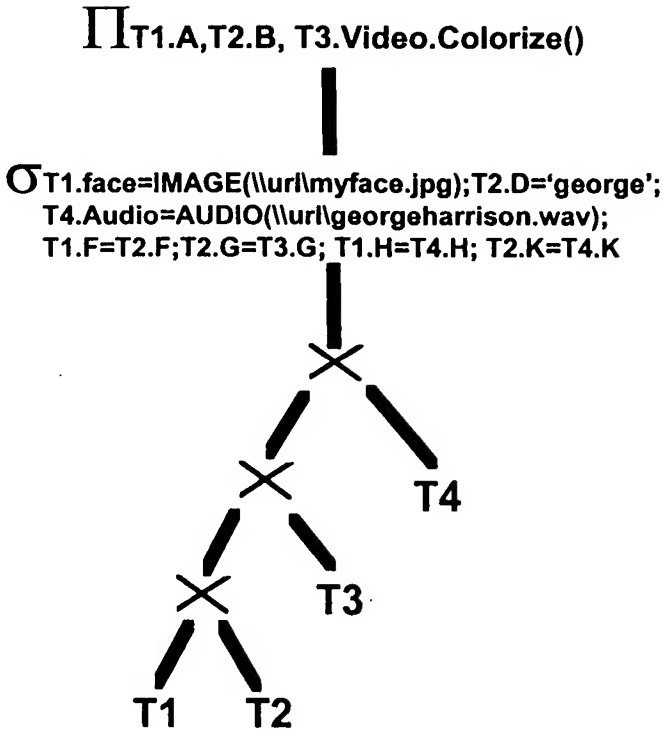
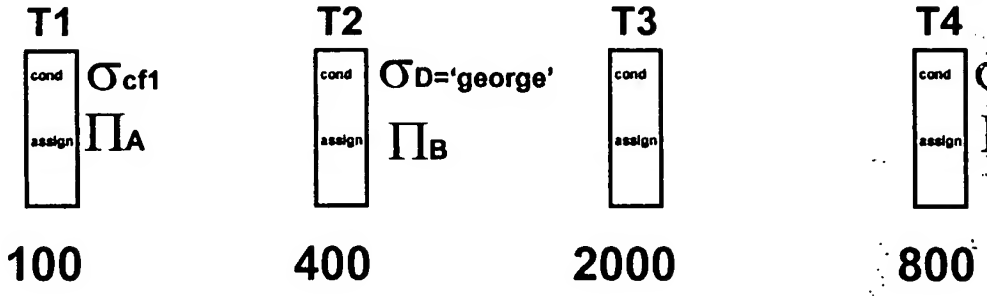


FIG. 9

```
Select T1.A, T2.B, T4.Video.Colorize() From T1, T2, T3, T4
    Where T1.face = IMAGE(\\url\myface.jpg)  AND T2.D='george'
      AND T4.Audio = AUDIO(\\url\georgeharrison.wav)
        AND T1.F=T2.F AND T2.G = T3.G AND T1.H = T4.H
          AND T2.K=T4.K;
```



T1.face = IMAGE(\\url\myface.jpg)	σ_{cf1}
T4.Video.Colorize()	Π_{cfs4}
T4.Audio = AUDIO(\\url\georgeharrison.wav)	σ_{cf4}

FIG. 10

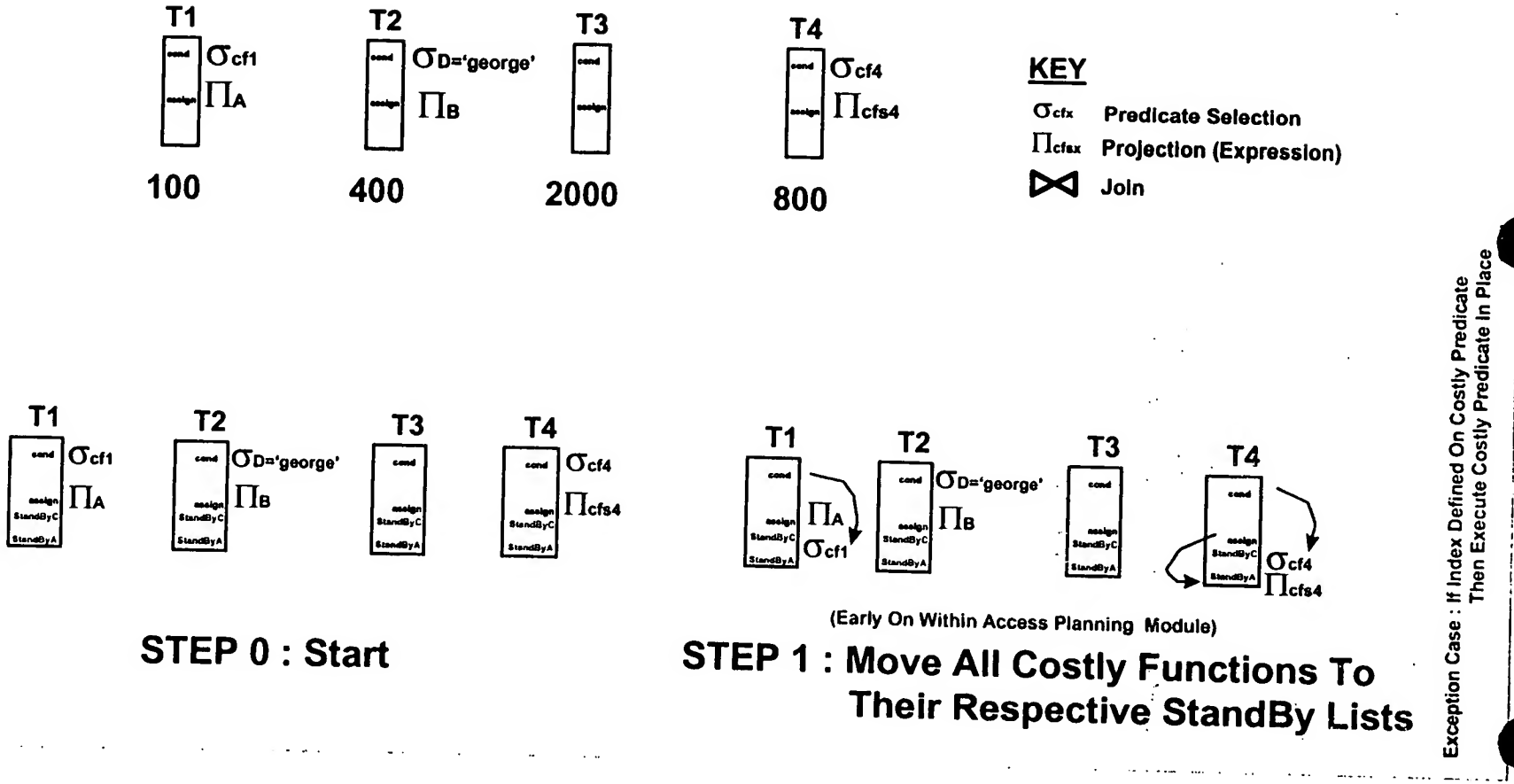
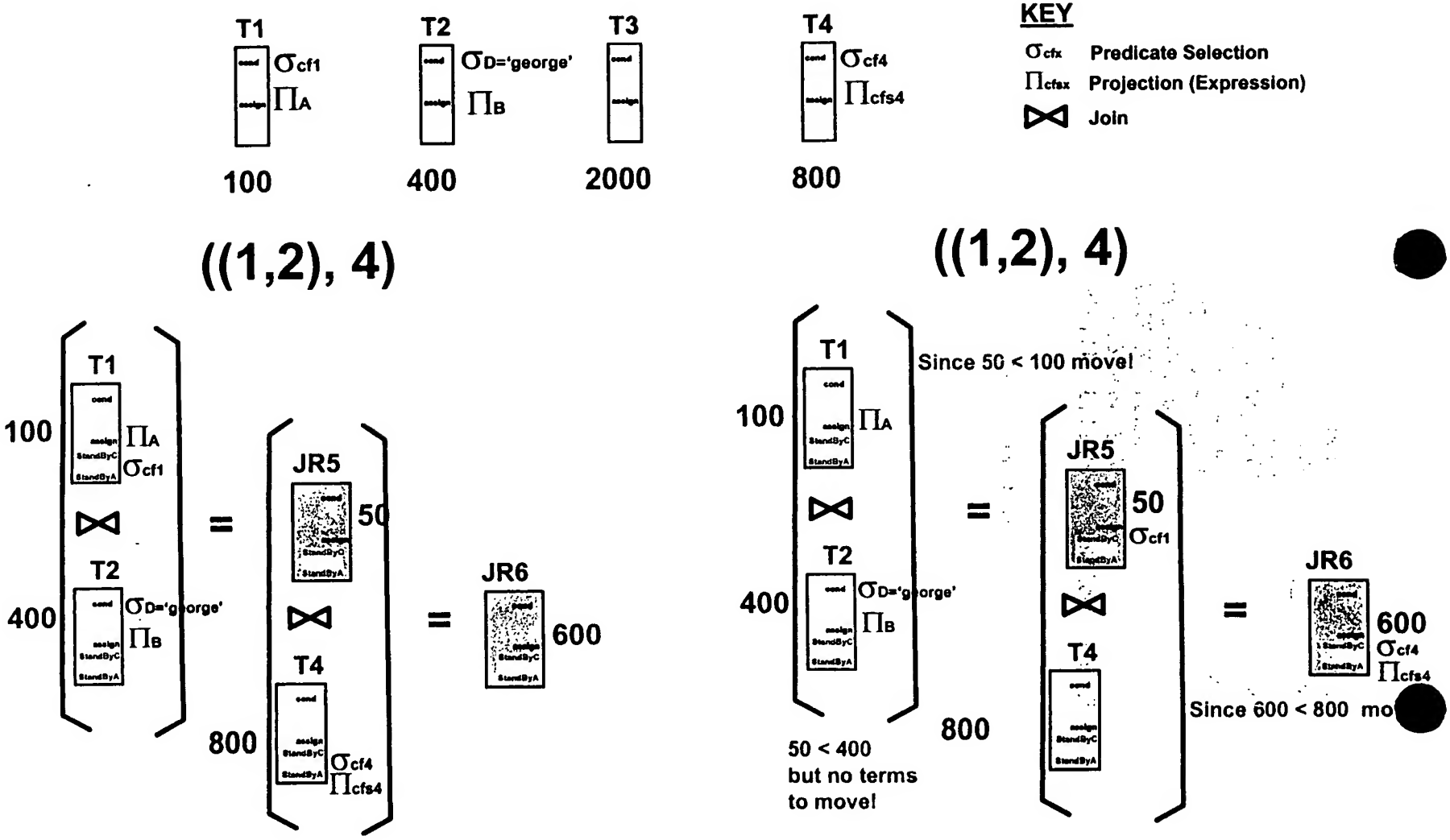

T1
cond
assign
σcf1
ΠA
100
T2
cond
assign
σD='george'
ΠB
400
T3
cond
assign
2000
T4
cond
assign
σcf4
Πcfs4
800
KEY
σcfx Predicate Selection
Πcfsx Projection (Expression)
⋈ Join
T1
cond
assign
StandByC
StandByA
σcf1
ΠA
T2
cond
assign
StandByC
StandByA
σD='george'
ΠB
T3
cond
assign
StandByC
StandByA
T4
cond
assign
StandByC
StandByA
σcf4
Πcfs4
STEP 0 : Start
T1
cond
assign
StandByC
StandByA
ΠA
σcf1
T2
cond
assign
StandByC
StandByA
σD='george'
ΠB
T3
cond
assign
StandByC
StandByA
T4
cond
assign
StandByC
StandByA
σcf4
Πcfs4
(Early On Within Access Planning Module)
STEP 1 : Move All Costly Functions To
Their Respective StandBy Lists
Exception Case : If Index Defined On Costly Predicate
Then Execute Costly Predicate In Place

FIG. 11

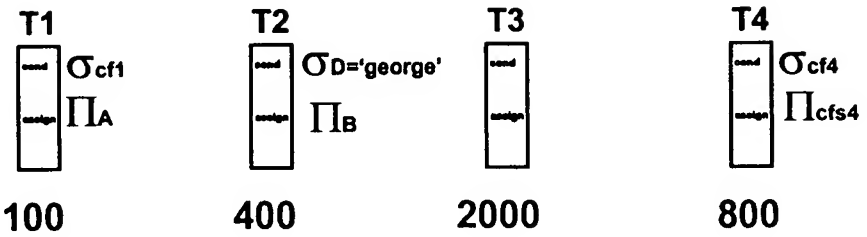
FIG. 12



STEP 2 : Calculate Access, Join Costs And All Cardinalities As Currently Done. (Ignoring Terms On StandBy)

(Triplet Costing Within LookAhead Module)

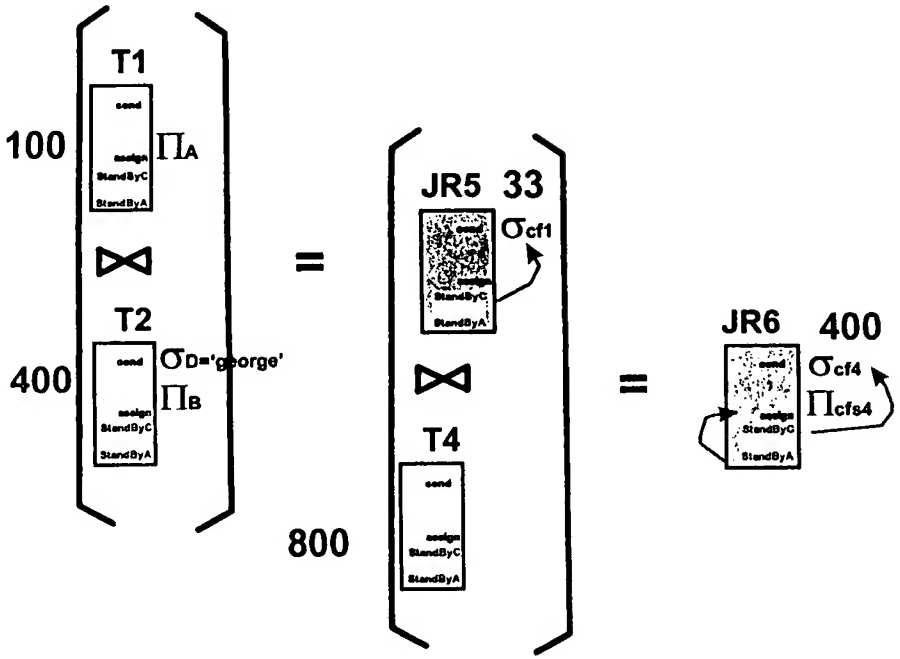
STEP 3 : Examine Cardinalities For The "Triplet" and Move Costly Functions Toward Lowest Cardinality.



KEY

- σ_{cfx} Predicate Selection
- Π_{cfsx} Projection (Expression)
- ⋈ Join

((1,2), 4)



(Triplet Costing Within LookAhead Module)

STEP 4 : Move Terms From StandBy Lists To Active Lists And Calculate New Join Cardinalities And "Tuned" Cost.

Repeat This Process For Every Triplet Containing Costly Funcs

FIG. 13